

**Session XI. Regulation, Certification and System Standards**

**N 93 - 14857**

**In-service Evaluation of Wind Shear Systems**  
**Capt. Sam Shirck, Continental Airlines**

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*C-5*

\*Picture of N88777

Good Afternoon Ladies and Gentlemen

This was our first bite of the windshear apple! A Continental Flight from Denver to Houston , August 7, 1975. Fortunately in this accident there was no loss of life, others have been far less so.

Following this occurrence, a comprehensive study was undertaken by Continental Airlines Flight Operations to establish procedures to prevent a re-occurrence of this type of accident. Text and simulator training were developed and employed shortly thereafter.

FAA mandated windshear training is now required, low level windshear alerting systems have been installed at some airports, terminal doppler weather reporting systems have been installed at two airports with 40 or more coming soon, since this accident.

Reactive windshear systems , the best answer industry had at the time, have been installed on many aircraft and are now required on all aircraft being delivered.

N88777 encountered a strong microburst tailwind component of over 60 knots just at rotation. In our mind, the present reactive windshear systems, by themselves, will not prevent this type of accident. TDWR and LLWAS will not be installed at all airports that are subject to these microburst phenomena. Therefore, an advanced warning system, predictive, if you will, is required for the safety of our passengers.

We have worked over the past two years with Bendix, Collins, Westinghouse, and Dr. Pete Sinclair of CSU to find a solution to the windshear problem that is cost effective and provides the margin of safety required. With the able assistance of the FAA aircraft certification office in Long Beach we have modified three aircraft in our fleet, 1 737-300 and 2 A-300's, to assist the vendors in data collection. The 737 was delivered from Boeing with a Sunstrand Mk V GPWS/WS system; it has been modified by adding another Sunstrand Mk V. Dr. Sinclair's IR unit, a modified Collins WXR-700 weather radar system, and an optical disk recording system. The A-300 aircraft have similar modifications, one featuring a modified Bendix RDR-4A radar and the other a Westinghouse MODAR 3000 system. Each aircraft has the Sunstrand reactive system installed to furnish a base line for windshear correlation. All windshear information is transparent to the flight deck and normal operating procedures are unaffected. Because of comprehensive windshear avoidance procedures developed by the FAA and NASA, and employed by our airline, no significant shears have been encountered. However, an enormous amount of data has been collected to aid in ground clutter reduction and moving target discrimination in the approach and departure areas.

Recent meetings with the FAA, NASA Langley, and the vendors make us feel that the windshear solution is at hand. We intend to proceed under the 5256 exemption and feel certification of a predictive windshear system will be possible in the mid 1993 time frame.

We would now like to present some display and alerting scenarios that the predictive systems will provide.

- 1) Landing- windshear detected 1.5 miles or more from aircraft.
- 2) Landing- windshear detected 1.5 miles or less from aircraft.
- 3) Takeoff- windshear detected prior to V1 within 5 miles.
- 4) Takeoff- windshear detected after V1 within 1.5 miles.
- 5) Takeoff- windshear detected after V1 1.5 to 5 miles

These efforts have been possible because of a true and abiding commitment to safety by Bendix, Collins, Sunstrand, Westinghouse and Dr. Sinclair.

We would like to express our appreciation for the advice, assistance and encouragement we've received from Dr. Bowle's group at NASA Langley. When it's dark in the tunnel it's nice to have someone not only have a candle, but to light it to show the way.

Thank you for your attendance



# Continental Airlines

## -CONDITIONS-

- AIRCRAFT - BELOW 1500 FT. ON FINAL
- WX - WINDSHEAR WITHIN 5NM

## -ALERTS-

WINDSHEAR  
AHEAD

FLASH 3 TIMES THEN STEADY-CANCELABLE-REARMED

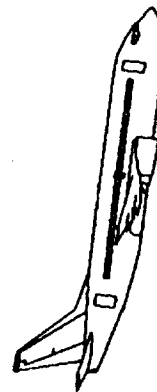
- LAMP

ATTESON/CHIME

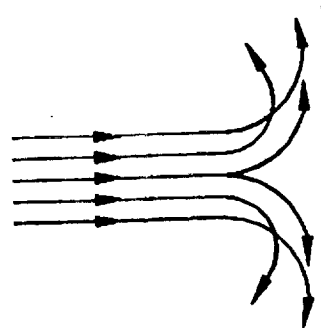
- AURAL
  - DISPLAY
- WINDSHEAR ICON YELLOW/BLACK  
POP UP IS OFF TO WX/WS MODE

## -PILOT ACTION-

- AS REQUIRED POTENTIAL TO MANUEVER AND AVOID
- REPORTS WS TO ATC
- NEGOTIATE AVOIDANCE AND/OR MANUEVER




1500 FT.  
AGL



1.5NM

5NM



# Continental Airlines

## —CONDITIONS—

- AIRCRAFT — BELOW 1500 FT. ON FINAL
- WX — WINDSHEAR WITHIN 1.5NM

## —ALERTS—

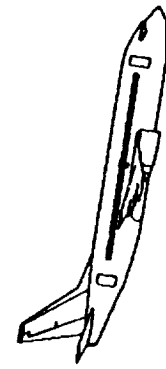
- LAMP

WINDSHEAR  
AHEAD <sup>R</sup>

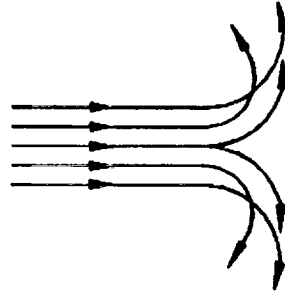
- AURAL "WINDSHEAR AHEAD" 1 REPEAT
- DISPLAY WINDSHEAR ICON RED/BLACK  
POP UP IS OFF TO WS MODE

## —PILOT ACTION—

- GO AROUND
- REPORTS WS TO ATC



1500 FT.  
AGL



1.5NM

5NM



Continental  
Airlines

24W

# CONDITIONS-

- AIRCRAFT - END OF RUNWAY TO V.
- WX - WINDSHEAR WITHIN 5NM



# ALERTS-

- LAMP - WINDSHEAR AHEAD TO ALL

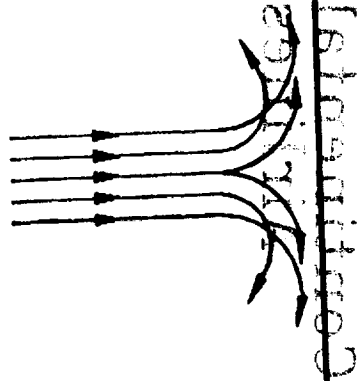
- AURAL - "WINDSHEAR AHEAD" - 1 REPEAT
- DISHIAO - WINDSHEAR ICON RED/BLACK POP UP IS OFF TO WS MODE

# PILOT ACTION

- ATC - "WINDSHEAR AHEAD" S REPEAT \*
- RTO
- REPORTS WS TO ATC

ATC 2-

- WS - WINDSHEAR BE WINDSHEAR
- ATC - BEYOND



5NM

1.5NM

A/C

TKO-3



Continental  
Airlines

—CONDITIONS—

- AIRCRAFT — BEYOND  $V_1$
- WX — ENCOUNTERED WINDSHEAR

—ALERTS—

- LAMP

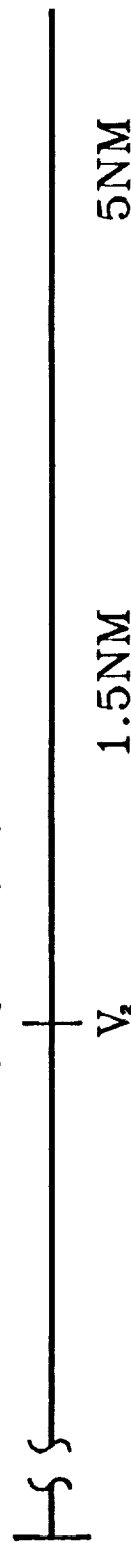
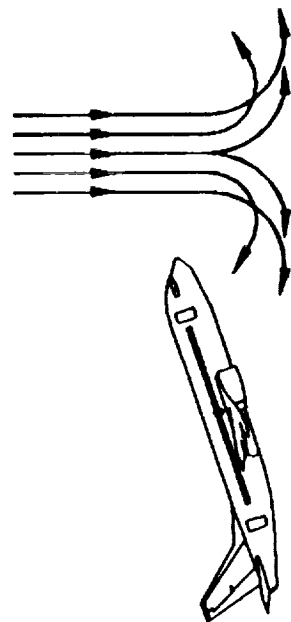


- AURAL\* "WINDSHEAR AHEAD" 2 REPEATS \*
- DISPLAY NONE

AURAL INHIBITED  
100 KNOTS TO ROTATION

—PILOT ACTION—

- WTARP
- REPORTS WS TO ATC







Continental  
Airlines

## --CONDITIONS--

- AIRCRAFT - TAKEOFF ROLL BEYOND V
- WX - WINDSHEAR BETWEEN 1.5NM AND 5NM

## --ALERTS--

- LAMP

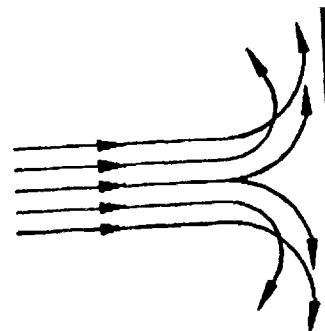
WINDSHEAR  
AHEAD

\* AURAL INHIBITED  
100 KNOTS TO ROTATION

- AURAL\* "WINDSHEAR AHEAD" 1 REPEAT
- DISPLAY WINDSHEAR ICON YELLOW/BLACK  
POP UP IS OFF TO WX/WS MODE

## --PILOT ACTION--

- TO MAX POWER
- NOTIFY ATC
- AVOID WS



V<sub>R</sub> V<sub>2</sub>

1.5NM

5NM

TKO-4

